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Review

A systematic literature review on delusional parasitosis

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Abstract

Objective: To collect detailed up-to-date knowledge, using a detailed systematic review of the literature, that is specific to the condition of Ekbom Syndrome, also known as Delusional Parasitosis (DP). This article will review: Historical facts, epidemiology, pathogenesis, clinical features, subtypes and related conditions, associated diseases, psychosocial impact, economic considerations and treatment. *Background:* DP is a psychiatric condition and can be the earliest sign of a major psychotic illness. The condition was described as early as the late 17th century in France. The etiology is neuro-chemical. The classic "matchbox" and "specimen" signs can lead to a successful diagnosis. Treatment is via a multidisciplinary approach. *Methods:* A detailed search strategy was utilized across six databases led by pre-specified keywords (62 in number), followed by the application of database-specific filters to scrutinize the hierarchy of literature, from guidelines, systematic reviews and randomized controlled trials to medical papers with weak evidence, including anecdotal reports. One article was translated from French. *Results:* Forty references were used to extract the most relevant data. This article is divided into sections of topics, starting from methodology to a conclusion. *Conclusion:* This review article will enable the medical researcher to obtain a detailed perspective of the condition of DP. Thus, a researcher can seek the highest available evidence from the literature and use it as a starting point for his original research.

Keywords: Delusional parasitosis; Ekbom; Morgellons; Matchbox sign; Specimen sign

Contents

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1. Materials and methods

A detailed search strategy was utilized across five databases: PubMed, The Cochrane Library, Scopus, metaRegister of Controlled Trials, and Open Gray. The search was conducted from June 15 to August 1, 2015.

The search was led by an exhaustive list of pre-specified keywords of free text, Medical Subject Headings (MeSH), and their combination. The number of keywords reached 62, and they were categorized into five main groups: delusional parasitosis (DP) disease nomenclature and related terminology, gender categorization, age groups, terminology of investigative modalities, and therapeutics' terminology. Boolean operators and truncation were used to narrow and expand the search, respectively.

This was followed by the application of database-specific filters (Tables 1-1 and 1-2). However, some restrictions (filters) were not applicable (N/A) due to the nature of some databases. Additionally, inclusion and exclusion criteria (Table 1-3) were created to scrutinize the hierarchy of available medical literature, from guidelines, systematic reviews, and randomized controlled trials (RCTs) to medical papers with weak evidence (including anecdotal reports).

The Critical Appraisal Skills Programme (CASP) appraisal tool was used to evaluate the papers from the filtered search results. This tool was practical and convenient due to a number of reasons. Many articles failed (scored low) during the analysis via the CASP tool due to multiple factors (Table 1-4). Among the appraised papers that were used to create this review article; four papers scored the highest. These four papers were heavily used in the citation of this literature review paper. It's worthy to mention that Lepping et al., 2007, was the only systematic review ever found in the literature search process across 6 different databases. No well-conducted RCTs or other systematic reviews were found, due to very low incidence of the disease.

Table 1-2
The filters (limits) that were applied across the searched databases.

Database	Applied filters
PubMed	English language Full text search Publication date in the last 5 years, were a priority Human studies only Systematic reviews, guidelines, RCTs & multicenter studies
The Cochrane Library	English language Publication date 2010 to 2015, were a priority Human studies only Full text search Top of the medical evidence hierarchy, were the prime target English language
Scopus	Articles and reviews under the topic of "Medicine" Literatures from all countries Humans only
Open Gray	N/A
Meta Register of controlled trials	N/A

Table 1-1
Total number of papers before and after the application of filters (limits).

	PubMed	The Cochrane Library	Scopus	metaRegister of Controlled Trials	Open Gray	Total no. of Articles (papers)
Total number of papers before limits' application	212	9	2	N/A	N/A	223
Total number of papers after limits' application	25	14	1	N/A	N/A	40

Table 1-3
Inclusion and exclusion criteria, used to filter the searched papers.

Inclusion criteria	Exclusion criteria
Primary DP, Secondary functional DP, Secondary organic DP, orificial DP, Delusory cleptoparasitosis, Delusional Infestation (DI), and Morgellons disease	Conditions related to the DP, including: Formication, and Illusions of parasitosis
Females and males (all age groups)	Literature of low quality level of evidence was conditionally excluded. Exclusion was based on low scoring on CASP critical appraisal tool
Literature of high level of evidence	
Literature from: Dermatology, Psychiatry, Neurology, Psychology and Entomology	

Table 1-4
The Critical Appraisal Skills Programme (CASP) appraisal tool.

Advantages of CASP tool	Causes of low scoring on CASP tool
Less time consuming compared with other appraisal tools (as in Duffy tool)	Small sample size
Appraisal is based on a series of questions (including screening questions at the beginning)	Weak randomization methods, allocation concealing and blinding techniques in case of Randomized Controlled Trials (RCTs)
Each question has a hint to guide you through the evaluated paper	High levels of bias
Two screening questions (at the beginning of CASP)	Short duration of studies
Questions covered the entire sections of the evaluated paper	No considerable follow up period
Questions were categorized into: validity, results and the application of results	No data concerning the relapse rate
Questions are answered by: "Yes", "No" and "Can't tell"	Lack of data on long term safety issues for certain therapeutic agents

2. Results and discussion

An in-depth analysis of the papers extracted via database search engines (Tables 2-1 and 2-2, Figs. 1-1 and 1-2), revealed:

- Out of 223 papers (prior to the application of filters and limits), only 40 papers (filters applied) were utilized for citation and referencing of this literature review paper. Out of the 40 cited references, only four papers scored with the highest level of evidence. These were thoroughly used in the citation of this paper.
- In the references, there were 7 types of papers: websites, textbooks, case reports, retrospective and cross-sectional studies, reviews and systematic reviews and others (where categorization of type of study was not applicable).
- The four papers (of the highest evidence) were review articles (3) and systematic reviews (1). In his systematic review, Lepping et al., 2007, studied the Antipsychotic treatment of primary of DP. It was the only systematic review found in the searched literature.

Table 2-1
Analysis of the utilized references.

		Web	Textbook	Case report	Retrospective & cross sectional studies	Reviews & systematic reviews	Guidelines	Others	Total no. of papers
Number of paper		7	1	15	4	6	0	7	40
Level of evidence		N/A	N/A	Low	Low	Variable (Moderate to high)	N/A	N/A	N/A
Year	Before 2010	N/A	0	7	1	4 (one systematic review included)	N/A	7	19
	After 2010	N/A	1	8	3	2	N/A	0	14

Table 2-2
Papers that scored with the highest level of evidence.

Title	Author	Type
Antipsychotic treatment of primary delusional parasitosis	Lepping et al. (2007)	Systematic review
Delusional parasitosis: a new pathway for diagnosis and treatment	Lepping and Freudenmann (2008)	Review article
Ekbom syndrome: The challenge of "invisible bug" infestations	Hinkle (2010)	Review article
Morgellons in dermatology	Harth et al. (2010)	Review article

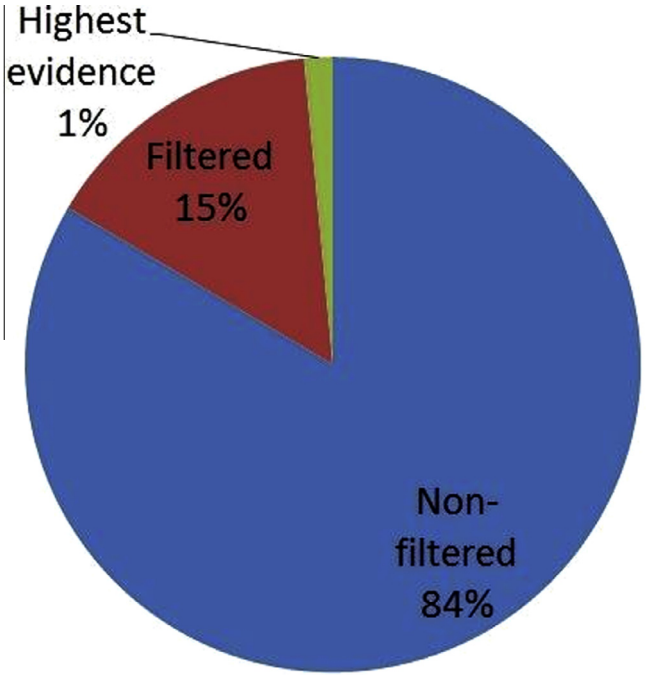

Figure 1-1. A pie chart for analysis of the relative contribution of searched papers.

3. Introduction

Patients with Delusional Parasitosis (DP), also known as *Ekbom syndrome* (ES), have the false/unshakeable belief that organisms/bugs are living in the skin and sometimes in other parts of the body. In young patients, DP can be the earliest sign of a major psychotic illness. It was first described by Thiebierge & Perrin (Table 3). Alistair Munro considered it a type of monosymptomatic hypochondriacal psychosis. Karl Ekbom described its principal manifestations in 1937–1938. In 1978, a pivotal monograph (by Annika Skott) with the term Dermatozoenwahn (coined by Ekbom) was published. Regarding a similar non-synonymous condition (but within the same delusional complex) called *Morgellons disease*, first described by Thomas Browne in 1690, named it *''Morgellons disease''*, which refers to a local area in France. She considered it a re-emergence of this ancient malady, which affected children of the Languedoc region of France in the 17th century, in which delusional skin infestation was by inanimate materials rather than bugs. Somatic delusions are among the most difficult conditions to treat in dermatology, and dermatologists must be sufficiently prepared to treat them; classical treatment is with anti-psychotics. (Millard and Millard, 2010; Lee, 2008; Bourgeois, 2011; Hinkle, 2010; Szepietowski et al., 2007; Harth et al., 2010).

4. Epidemiology and demographics

Psycho-cutaneous disorders are more common in females; however, DP affects both sexes equally below 50 years of age, and the male-to-female ratio of having the disease is 1:3. DP is considered rare (Table 4); however, Ekbom stated that it is common for mentally ill people to believe they have creatures in and/or on the body. DP affects 2.37–17/million/year. The age of onset ranges from 55 to 68 years; however, primary DP may occur in adolescents, and those in the age group of 20–40 years must be dealt with the utmost concern due to recreational drugs that may trigger or cause DP. The average duration of

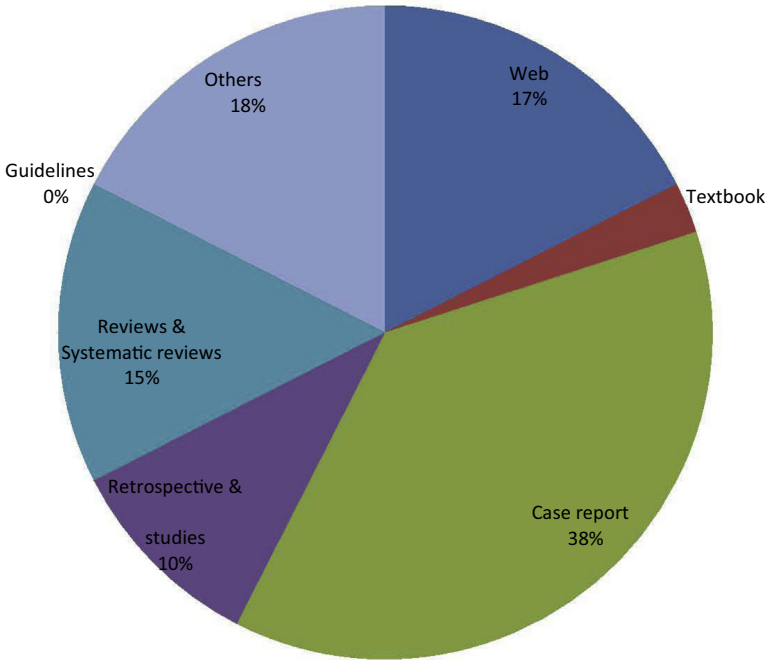

Figure 1-2. A pie chart for analysis of the type of papers that were utilized as references.

Table 3
Historical landmarks & scientific progression in Delusional Parasitosis (DP). *Sources:* Bourgeois (2011), Harth et al. (2010), Hinkle (2010), Lee (2008), Millard and Millard (2010) and Szepietowski et al. (2007).

Scientist	Year	Event
Thomas Browne	1690	1st description of Morgellons disease in France
Thiebierge & Perrin	1894, 1896	1st description of DP
Karl Axel Ekbom	1937–1938	Described the principal features of DP
Annika Skott	1978	Pivotal monograph on DP, with the title term "Dermatozoenwahn", was published
Mary Leitao	2002	Used the term "Morgellons disease"

Table 4
Szepietowski et al. (2007) survey, dermatologists encountering cases of Delusional Parasitosis (DP). *Source:* Szepietowski et al. (2007).

Period of practice	Dermatologists participating in the survey	Notes
Whole practice	84.7%	Saw at least 1 case
Whole practice	28%	Treated 3–5 cases
Past 5 years	23%	Diagnosed no cases
Past 5 years	7%	Saw more than 10 cases
N/A	20%	Were currently treating a case of DP
	40.7%	Always asked for a psychiatric opinion about DP cases
	28.8%	Often asked for a psychiatric opinion about DP cases

the disease is 3 years, but it may last decades. There are no socio-economic, racial or peculiar predilections; however, social demographics can be a factor. Many ES-sufferers are intelligent, high-functioning, professionals, medical professionals and even psychologists. (Millard and Millard, 2010; Hinkle, 2010; Szepietowski et al., 2007; Harth et al., 2010; Ehsani et al., 2009; Olari, 2011).

5. Pathogenesis

DP may evolve as sensory misinterpretation that transforms into a tactile hallucination and consolidates into delusions, or a hallucination that progresses to somatic delusion. To understand the pathogenesis, it is essential to know the DP subtypes (Table 5-1) (Hinkle, 2010; Wikipedia, n.d.):

DP's exact etiology is multifactorial. It is of a neurochemical base, and this is confirmed by DP-triggering by psychoactive agents, such as cocaine and amphetamine, its association with neuro-hormonal disorders and the aging process (Table 5-2) (eMedicine, n.d.).

Huber et al. (2008) proposed that decreased striatal dopamine transportation (DAT) leading to increased extracellular dopamine underlies DP pathogenesis, and this was confirmed by Millard and Millard (2010):

- Primary DAT inhibitors (cocaine, pemoline, bupropion, amphetamines & others).
- Secondary DAT dysfunction (Parkinson's disease, brain injury & others).

Huber et al. (2008) made the first structural MRI study showing the relevance of structural lesions in the corpus striatum (mainly the putamen) in secondary organic DP. This caused disturbed functioning of the putamen (which mediates motor & visuo-tactile perception) and associated brain areas of the somatic dorsal striato-thalamo-cortical loop. Moreover, the involvement of the striatum and the efficacy of antidopaminergic-antipsychotics in treating DP indicate dopaminergic dysfunction in DP. Freudenmann

Table 5-2
Multifactorial contribution to the pathogenesis of delusional parasitosis in elderly people. *Source:* Hinkle (2010).

Senile pruritus
Increased incidence of diabetes mellitus-associated diabetic neuropathy
Reduced visual acuity
Reduced blood flow due to arterial stenosis (produces paresthesia)
Loss of autonomy, leading to depression & low self-esteem
Polypharmacy in the elderly
Frequent taking of over-the-counter drugs/supplements/herbal remedies
Other medical conditions

Table 5-1
Main classification/subtypes of delusional parasitosis. *Sources:* Hinkle (2010) and Wikipedia (n.d.).

Type of DP	Causes/association
Primary/true/autochthonous	Independent of any medical or associated psychiatric condition, there is no additional deterioration of basic mental functioning
Secondary functional	Associated with psychiatric conditions, such as schizophrenia and depression
Secondary organic	Caused by medical illness or recreational substance abuse

et al. (2010), suggested the role of postsynaptic-D2 receptors in mediating the anti-psychotics' effect and gave the first evidence of fronto-striato-thalamo-parietal brain circuits in mediating Delusional Infestation (DI), which is in the same spectrum as DP (Millard and Millard, 2010; Hinkle, 2010; Wikipedia, n.d.; eMedicine, n.d.; Brewer et al., 2008; Huber et al., 2008; Freudenmann et al., 2010; Bury and Bostwick, 2010).

6. Clinical features

Presentation can be diverse, and patients are regular visitors to hospitals, persisting in their need for a cure. More advanced/established cases involve repeated consultations to specialist services (emergency physicians, family physicians, entomologists, veterinary services and even esteemed scientists) to eradicate the imagined infestation. Patients may present with ill-defined, persistent itching without evident delusions (Millard and Millard, 2010). This is sometimes accompanied by the cutaneous sensation of bugs (formication), or even visual confirmation of bugs, involvement of the genital, oral or ocular areas (orificial DP) (Millard and Millard, 2010; Wikipedia, n.d.). Pruritus is reported in more than 80% of sufferers, and others describe crawling, burrowing and biting. Attempts to extract the bugs produce extensive skin excoriations, which can also present with bruising, traumatic alopecia, contact dermatitis and scarring (Harth et al., 2010; Hinkle, 2010; Millard and Millard, 2010).

To relieve symptoms, the patient uses: Scissors, files, needles, penknives and tweezers, and the most disturbed patients use surgical instruments, chemicals, corrosives and pesticides. Old self-mutilated lesions appear: Lichenified, excoriated, ecthymatous or crusted (Harth et al., 2010; Hinkle, 2010; Millard and Millard, 2010). Patients usually provide a small container (matchbox, pill container or a sealed plastic bag), classically known as a "matchbox sign", or better called a "specimen sign", enclosing the assumed/imagined organisms. On microscopy, samples appear to be hair, skin, fabric, dust, dirt, serum, ants and fleas, but devoid of real pathogenic organisms (Freudenmann et al., 2010; Millard and Millard, 2010).

The patient may even provide detailed description(s) and/or drawing(s) of the organisms' movement/life cycle (Millard and Millard, 2010). A scientist claimed he had discovered a new insect that infested his skin, and he made detailed sketches of the insect and its copulation as seen by him under microscopy (Hinkle, 2010).

Table 6-1
Variants, subtypes and conditions related to Delusional Parasitosis (DP). *Sources:* Dewan et al. (2011), Hinkle (2010), Hylwa et al. (2012), Lee (2008), Millard and Millard (2010), Prološčić et al. (2012) and Wikipedia (n.d.).

Condition	Description/notes
Primary DP	No organic or psychiatric causes
Secondary functional DP	Associated with other psychiatric conditions
Secondary organic DP	Caused by medical illness or recreational substance abuse
Orificial DP	A variant of DP involving body orifices
Delusory cleptoparasitosis	A form of DP; patients think the organism is in their dwelling
Delusional infestation (DI)	Includes both DP & delusion of infestation with inanimate objects. Patients usually have other psychiatric disorders (Dewan et al., 2011; Hylwa et al., 2012)
Morgellons disease	Includes delusional infestation with cognitive defects/behavioral changes/tiredness & others (Lee, 2008; Prološčić et al., 2012; Wikipedia, n.d.)
Formication	Similar to DP, but patients are not delusional (i.e. they can be convinced with evidence that they do not have a real infestation.)
Illusions of parasitosis	Produced by actual physical causes. As insulation/static electricity/fragments that feel like stings & various allergens/materials, such as formalin, produce dermatitis, such individuals are not delusional and are convinced when the condition is explained (Hinkle, 2010)

Table 6-2
Case reports of interest, association with secondary Delusional Parasitosis (DP). *Source:* Flann et al. (2010), Fleury et al. (2008), Hanihara et al. (2009) and Omar et al. (2009).

DP association	Study/year	Description/notes
Thalamic pain syndrome	Hanihara et al. (2009)	Due to left-posterior thalamic hemorrhage, the patient initially suffered thalamic pain syndrome, then developed delusional oral parasitosis (Hanihara et al., 2009)
Fronto-Temporal lobar degeneration (FTLD)	Omar et al. (2009)	Among 8 cases, only 2 showed DP; others showed more prominent paranoid & somatic delusions (Omar et al., 2009)
Topiramate-induced DP	Fleury et al. (2008)	1st reported case of TPM-induced DP during course of Rx of 48-year-old woman with temporal lobe epilepsy (Fleury et al., 2008)
Dopamine agonist-induced DP	Flann et al. (2010)	Three cases of DP in patients with well-established Parkinson's disease, all of whom were taking dopamine agonists. DP resolved rapidly when offending drug was stopped (Flann et al., 2010)

6.1. Shared delusion

About 5–15% of patients have associated delusion with a close relative; these are mostly female family members or sympathetic/submissive/socially and culturally-isolated individuals. Such delusions are called "folie à deux", "folie à trois" and "folie a famille" (folie is the French word for "madness"). Recently, the role of the media and internet has been observed in shared delusions (referred to as "folie à Internet" or "cyberchondria"). The quality of life of the patient and their family members is severely jeopardized. (Millard and Millard, 2010; Harth et al., 2010; Wikipedia, n.d.; Daniel and Srinivasan, 2004).

6.2. Variants, subtypes and related conditions

Many variants, subtypes and related conditions of DP exist (Table 6-1). Similarly, there are numerous conditions that may coexist with DP (Millard and Millard, 2010; Lee, 2008; Hinkle, 2010; Wikipedia, n.d.; Hylwa et al., 2012; Dewan et al., 2011; Prološčić et al., 2012).

6.3. Associated diseases

DP can occur in disease, affecting the non-dominant hemisphere, as in Cerebro-Vascular Accidents (CVA). Structural brain abnormalities that have been reported include subcortical vascular encephalopathy and right hemisphere stroke in the temporo-parietal cortex. Similarly, DP can be a part of senile dementia. It has also been described in pellagra, B12-deficiency, after coronary bypass surgery, as a side-effect of phenelzine, severe renal disease and others (Tables 6-1–6-3). In a young adult, recreational drug abuse must be considered (Millard and Millard, 2010; Brewer et al., 2008; Huber et al., 2008; Hanihara et al., 2009; Omar et al., 2009; Fleury et al., 2008; Flann et al., 2010).

6.4. Histopathology

Skin histology is completely normal without specific findings; however, secondary lesions due to rubbing, scratching and picking. While other patients, may attempt to persecute the invisible organism or the inanimate subject can lead to lichenification, excoriations, ecthymatous changes, bruising, traumatic-alopecia, contact dermatitis and scarring. (eMedicine, n.d.; Harth et al., 2010; Hinkle, 2010; Millard and Millard, 2010).

Table 6-3
Disorders associated with secondary Delusional Parasitosis (DP). *Source:* Millard and Millard (2010).

Systems	Disease/disorder
Neurological	Dementia and neurodegenerative diseases Parkinson's disease Huntington's disease CNS tumors Head injuries Encephalitis Meningitis Multiple sclerosis Learning disability
Cardiovascular disorders	Arrhythmias Heart failure Coronary artery bypass
Renal diseases	Chronic renal failure Dialysis
Liver disease	Hepatitis
Endocrine disease	Diabetes mellitus Hyperthyroidism Hypothyroidism Panhypopituitarism Hyperparathyroidism Acromegaly
Nutritional disorders	Pellagra Folate deficiency Vitamin B12 deficiency Anorexia nervosa
Infectious diseases	Syphilis AIDS Tuberculosis Leprosy
Malignancy	Breast cancer Colon cancer Lung cancer Lymphoma Chronic lymphatic leukemia
Substance abuse	Amphetamines Cannabis Cocaine Ecstasy Opiates
Medicines	Corticosteroids Ciprofloxacin Mefloquine Pemoline Phenelzine Pargyline

7. Psychological, social, and economic impact

As in any psychological or physical disfiguring skin disorder, there is a negative impact on body image and self-esteem. Depression, frustration, anxiety and social phobia may develop. Even the management of DP is always challenging and frustrating. To quote a patient's frustration: "My creepy crawlies definitely caused anxiety and agitation. I remember fantasizing about cutting my own skin open and ripping my leg muscles to shreds". Moreover, shared delusions (Table 7-1) will jeopardize the quality of life of both the patient and their family and make treatment more challenging (AAFP, n.d.; Millard and Millard, 2010; Sciencebasedmedicine, n.d.).

Suicide is a risk in such patients, and they should be admitted to hospital and to be carefully monitored. In severe DP, the physician may persuade the patient that treatment is necessary because of the psychological impact,

Table 7-1
Shared delusion between family members. *Source:* Millard and Millard (2010).

Familial relation	Percentage
Between sisters	34%
Wife & husband	20%
Mother & child	20%
Between brothers	9%
Fathers & sons	2%

Table 7-2
Boggild et al. (2010) study of social impact in Delusional Parasitosis (DP). *Source:* Boggild et al. (2010).

Social impact	Percentage of patients
Affected personal life	87
Household members affected	62.5
Decreased employment	62.5
Reduced social contact with family	50
Reduced social contact with non-family	75
Contagiousness was a concern/preoccupation	62.5
Alcohol use/abuse	25
Sedative use/abuse	37.5
Rated medical care as "poor"	63
Rated medical care as "very good"	25
Believed there is a cure for their condition	63

Table 7-3
Causes behind high economic impact in Delusional Parasitosis (DP). *Sources:* Boggild et al. (2010) and Millard and Millard (2010).

Specialist referrals, doctor shopping/physician odyssey
Utilization of many laboratory/diagnostic resources
Thorough initial work-up, which may be repeated by multiple different physicians
Consumption of the microbiology/parasitology laboratories' resources
Self-financed diagnostic evaluations
Absences from work and consequences of unemployment
Self-imposed limitations on social interaction, family disruption
Utilization of toxic & caustic chemicals/drugs/remedies
Substance abuse
Fears of contagion & social phobia
Referral of DP patients to psychiatry presents a major challenge

telling them that the organism can be virulent in psychologically and physically-fragile individuals. DP can revolve on a bio-psycho-social management model in collaboration with psycho-dermatologists, where stress reduction is pivotal (Lawrence-Smith, 2009; Millard and Millard, 2010; Therapeutique-dermatologique, n.d.). Chronic DP will eventually result in skin scarring. In all chronic scarring dermatoses, psychosocial and economic impact are evident (Tables 7-2 and 7-3) (Boggild et al., 2010; Brown et al., 2008; Evers et al., 2008; Hong et al., 2008; Koblenzer, 2005; Millard and Millard, 2010).

8. Treatment

8.1. Title

The dilemma in DP (especially the primary type) is convincing the patient that their condition is psychiatric. Therefore, solid doctor-patient trust is essential (Table 8). If left untreated, DP becomes fortified against further measures. Delusion almost never resolves itself naturally, but there is a 50% chance of remission if a psychotropic drug is administered early after the onset of symptoms. A multi-disciplinary approach between physicians, laboratory workers, entomologists and pest control organizations is essential. The physician must struggle until the patient is motivated to use a specific therapy, usually a combination psychiatric and psychosomatic therapy. It is vital to watch for secondary and self-induced skin lesions, such as cellulites, bruising, traumatic-alopecia, contact dermatitis and scarring. The underlying cause in secondary DP should never be forgotten (Harth et al., 2010; Hinkle, 2010; Lee, 2008; Millard and Millard, 2010; Prakash et al., 2008) (See Fig. 2).

The current first-line treatment is risperidone and olanzapine (atypical or second-generation anti-psychotics), and the classical treatment was Pimozide (first-generation

Table 8
Step-by-step approach to gain solid rapport with patients of delusional parasitosis. *Source:* Harth et al. (2010), Hinkle (2010), Lee (2008) and Millard and Millard (2010).

First consultation/encounter is crucial
It is important to look, listen & be empathetic
Comfort patient by saying that this condition has been seen/treated before
Reduce patient's agitation/preoccupation
Conduct a thorough skin examination
Microbiological/parasitological testing to be conducted of the patient's "specimens"
Examine more "specimens" in the consulting room & laboratories
Pay attention to recreational drug abuse
Avoid being misunderstood by patient as supporting their delusions
Acknowledge that the patient's symptoms are real (though delusional)
Avoid premature confrontation with patient
Delusional patients who perceive agreement or confrontation are difficult to treat
Within 2–3 visits, it is possible to start to explore/discuss the whole illness to patient
Shakeability of delusion can be estimated at this point of time
Start with non-irritating local therapy for self-induced lesions
For patients with anxiety/depression, anti-depressants can be offered
Psychotherapeutics should only be suggested when you gain patient's trust
If offered, very few delusional patients would accept an antipsychotic agent
Psychiatrist help can be utilized in immediate future
Psychiatric colleague can see the patient in the dermatology ward
When starting anti-psychotics, initially it is better to hospitalize patient.
Family members must ensure/monitor patient's compliance with therapy
Be cautious if shared delusion exists among family members
Further management is joint consultation with psychiatry department

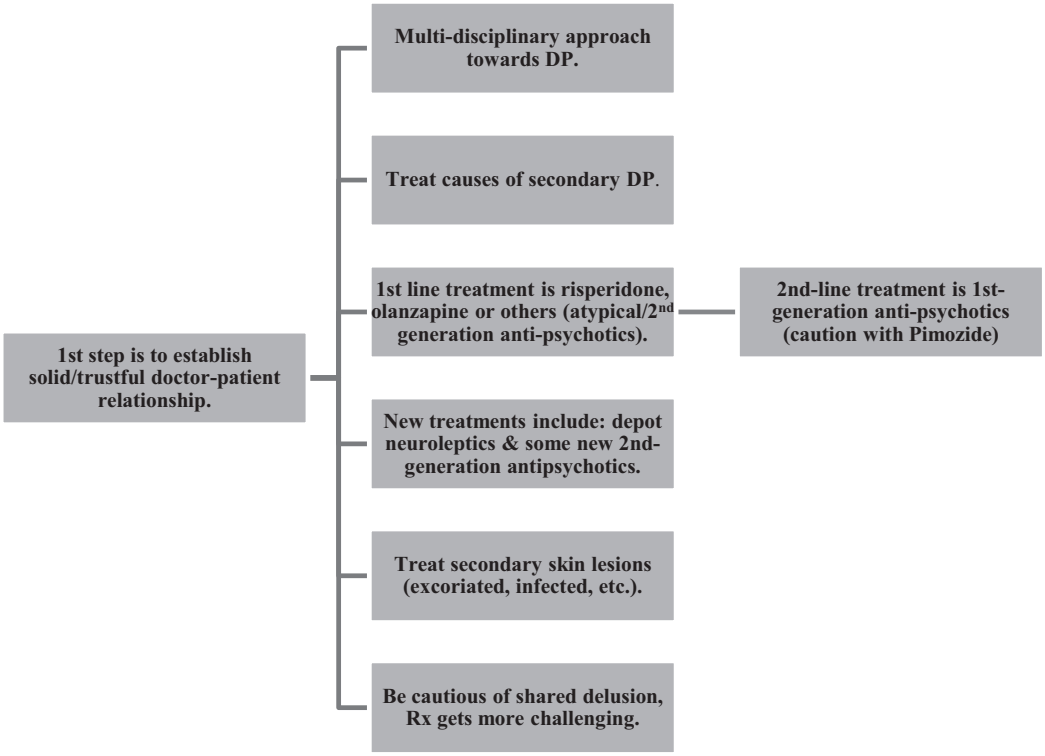

Figure 2. Treatment algorithm for Delusional Parasitosis (DP). *Source:* Harth et al. (2010), Hinkle (2010), Lee (2008), Millard and Millard (2010) and Prakash et al. (2008).

anti-psychotics). Pimozide showed recovery in 90% of cases; however, due to its risk profile (extrapyramidal and cardiac toxicity), Pimozide is now the second-line treatment. However, safer first-generation treatment includes: Haloperidol, perphenazine and sulpiride (eMedicine, n.d.; Harth et al., 2010; Lee, 2008).

Atypical (second-generation) anti-psychotics have a safer profile and are better tolerated (than Pimozide); however, major risks include metabolic dysfunction. Risperidone (dopamine blocker and serotonin antagonist) treat DP effectively at 1–8 mg/day. Olanzapine (a higher affinity serotonin blocker than dopamine antagonist) is effective at 5–10 mg/day. Full remission with second-generation antipsychotics is accomplished in 75% of cases within 3 months of therapy. Safe first-generation treatment is used as a second-line treatment, with sulpiride (selective dopamine antagonists) at 200–400 mg/day. Hanihara et al. (2009) reported an unusual association of thalamic pain syndrome with DP, which was efficiently treated within 3 months using Sulpiride (100 mg/day) and amitriptyline (eMedicine, n.d.; Freudenmann et al., 2010; Hanihara et al., 2009; Harth et al., 2010; Lee, 2008; Lepping and Freudenmann, 2008; Millard and Millard, 2010; Wikipedia, n.d.).

Pimozide (as the second-line option): The initial dose is 2 mg/day, increased by 2 mg/week, up to 12 mg/day; however, Pimozide can be effective at 2–4 mg/day. If the patient's improvement persists, Pimozide is decreased gradually by 1 mg every 1–2 weeks to reach the maintenance dose or total weaning; however, if the patient deteriorates later, Pimozide can be restarted in a time-limited fashion to control an episode rather than continuous treatment. Similar recurrence may occur with atypical antipsychotics in DP, DI and Morgellons disease (Bourgeois, 2011; Hinkle, 2010; Lee, 2008; Millard and Millard, 2010).

8.2. New treatments

Freudenmann et al. (2010) reported the first effective use of aripiprazole (atypical antipsychotic) in drug-induced DI and ziprasidone in organic DI. Contreras et al. (2012) reported a good response to Pimozide combined with ziprasidone, an atypical antipsychotic (with a lower risk of extrapyramidal manifestation); thus, ziprasidone might be a good first treatment option.

Depot anti-psychotics can be considered in the case of a patient's poor compliance with oral medications. To convince the patient of such an approach (depots), the "hy posensitization" motivational strategy is used by explaining to the patient that their condition is analogous to extreme hypersensitivity of the most peripheral skin nerves. (Millard and Millard, 2010; Freudenmann et al., 2010; Lepping and Freudenmann, 2008; Contreras-ferrer et al., 2012; Freudenmann et al., 2009; Bahmer and Bahmer, 2002).

9. Conclusion

DP is a unique psychosomatic disorder that is challenging to both the patient and physician, and first descriptions date back to the 17th century. Delusional infestation and

Morgellons disease are within the same delusional complex. DP is rare with a mean age of onset from the sixth to seventh decades; however, it may occur from the second to fourth decades, where recreational substance abuse should be considered. DP can be either primary or secondary. Pathogenesis points to central neuro-hormonal mechanisms. Shared delusion can be a dilemma. The psycho-socio-economic impact is a massive burden. Treatment is via the multi-sectorial approach with a prime target to build trust and rapport with the patient to avoid "physician odyssey" and psychotherapy using second-generation anti-psychotics as the first line of treatment; however, disease recurrence is common.

Conflict of interest

The author declares that there are no conflicts of interest.

Disclosures and acknowledgements

None.

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